

Notice No.3

Rules and Regulations for the Classification of Ships, July 2021

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Please note that corrigenda amends to paragraphs, Tables and Figures are not shown in their entirety.

Issue date: November 2021

Amendments to	Effective date	IACS/IMO implementation (if applicable)
Part 3, Chapter 1, Sections 1 & 7	1 January 2022	1 January 2022
Part 3, Chapter 4, Section 5	1 January 2022	1 January 2022
Part 3, Chapter 4, Section 8	1 January 2022	N/A
Part 3, Chapter 9, Sections 3 & 6	1 January 2022	N/A
Part 3, Chapter 13, Sections 1, 7, 8, 9 & 10	1 January 2022	1 January 2022
Part 4, Chapter 2, Section 2	1 January 2022	N/A
Part 4, Chapter 12, Section 2	1 January 2022	N/A

Part 3, Chapter 1

General

■ Section 1 Rule application

1.2 Exceptions

1.2.2 The requirements of [Pt 3, Ch 1, 7.1 Calculation of Equipment Number](#) are not applicable to Double Hull Oil Tankers or Bulk Carriers with a CSR notation (see [Pt 1, Ch 2, 2.3 Class notations \(hull\)](#)).

■ Section 7 Equipment Number

7.1 Calculation of Equipment Number

7.1.1 The equipment of anchors and chain cables specified in [Pt 3, Ch 13, 7 Equipment](#) is based on an 'Equipment Number' which is to be calculated as follows:

~~$$\text{Equipment Number} = \Delta^{2/3} + 2BH + \frac{A}{10}$$~~

$$\text{Equipment Number} = \Delta^{2/3} + 2(BH + S_{\text{fun}}) + \frac{A}{10}$$

where

A = area, in m^2 , in profile view of the hull, within the Rule length of the vessel, and of superstructures and houses and funnels above the summer load waterline, which are within the Rule length of the vessel, and also having a breadth greater than $\frac{B}{4}$. The side projected area of the funnel is considered in A when A_{FS} is greater than zero. In this case, the side projected area of the funnel should be calculated between the upper deck, or notional deck line where there is local discontinuity in the upper deck, and the effective height h_{F} .

✍ See also [Pt 3, Ch 1, 7.1 Calculation of Equipment Number 7.1.3](#) and [Pt 3, Ch 1, 7.1 Calculation of Equipment Number 7.1.4](#) and [Pt 3, Ch 1, 7.1 Calculation of Equipment Number 7.1.5](#).

B = greatest moulded breadth, in metres.

H = freeboard amidships, in metres, from the summer load waterline to the upper deck, plus the sum of the heights at the centreline, in metres, of each tier of houses having a breadth greater than $\frac{B}{4}$ effective height, in m, from the summer load waterline to the top of the uppermost house.

$$H = a + \sum h_i$$

a = vertical distance at hull side, in m, from the summer load waterline amidships to the upper deck.

h_i = height, in m, on the centreline of each tier of houses having a breadth greater than $\frac{B}{4}$; for the lowest tier, h_1 is to be measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck, see [Figure 1.7.1 Computation of 'H'](#) for an example.

✍ See also [Pt 3, Ch 1, 7.1 Calculation of Equipment Number 7.1.2](#), [Pt 3, Ch 1, 7.1 Calculation of Equipment Number 7.1.3](#) and [Pt 3, Ch 1, 7.1 Calculation of Equipment Number 7.1.4](#)

Δ = moulded displacement, in tonnes, to the summer load waterline.

S_{fun} = effective front projected area of the funnel, in m^2 , defined as:

$$S_{\text{fun}} = A_{\text{FS}} - S_{\text{shield}}$$

✍ See also [Pt 3, Ch 1, 7.1 Calculation of Equipment Number 7.1.5](#).

A_{FS} = front projected area of the funnel, in m^2 , calculated between the upper deck at centreline, or notional deck line where there is local discontinuity in the upper deck, and the effective height h_{F} . A_{FS} is taken equal to zero if the funnel breadth is less than or equal to $\frac{B}{4}$ at all elevations along the funnel height.

h_{F} = effective height of the funnel, in m, measured from the upper deck at centreline, or notional deck line where there is local discontinuity in the upper deck, and the top of the funnel. The top of the funnel may be taken at the level where the funnel breadth reaches $\frac{B}{4}$.

S_{shield} = the section of front projected area A_{FS} , in m^2 , which is shielded by all deck houses having breadth greater than $\frac{B}{4}$. If there is more than one shielded section, then the individual shielded sections i.e. S_{shield1} , S_{shield2} etc as shown in [Figure 1.7.2 Computation of \$S_{\text{shield}}\$](#) to be added together. To determine S_{shield} , the deckhouse breadth is assumed B for all deck houses having breadth greater than $\frac{B}{4}$ as shown for S_{shield1} , S_{shield2} in [Figure 1.7.2 Computation of \$S_{\text{shield}}\$](#) .

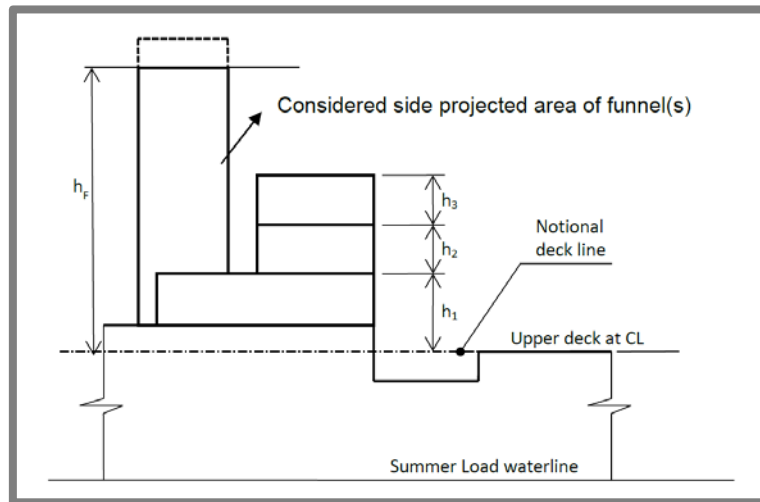


Figure 1.7.1 Computation of ' H '

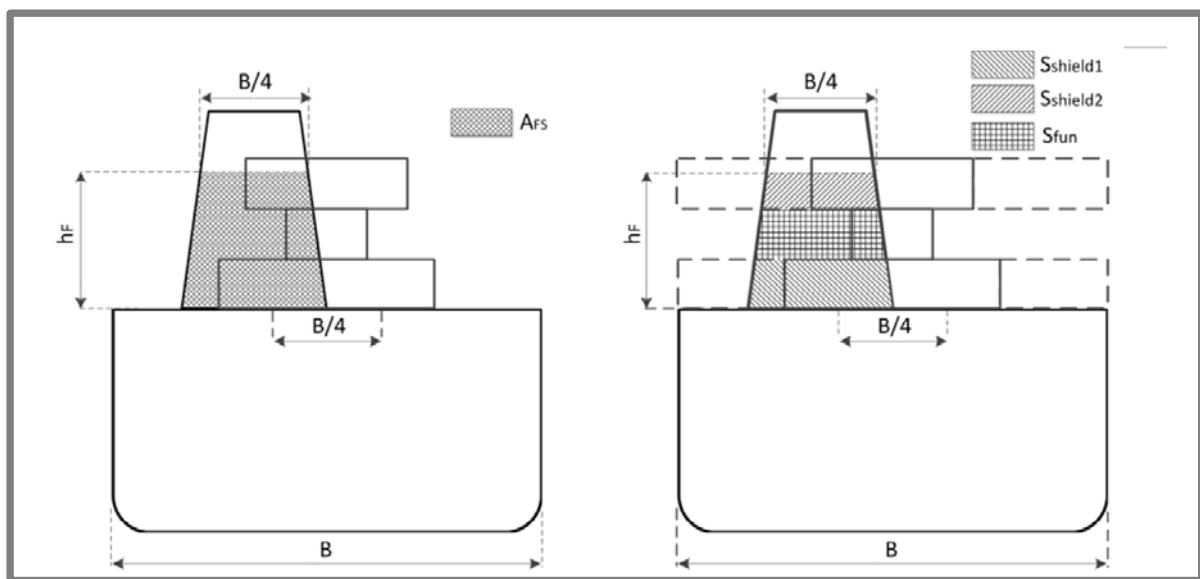


Figure 1.7.2 Computation of S_{shield}

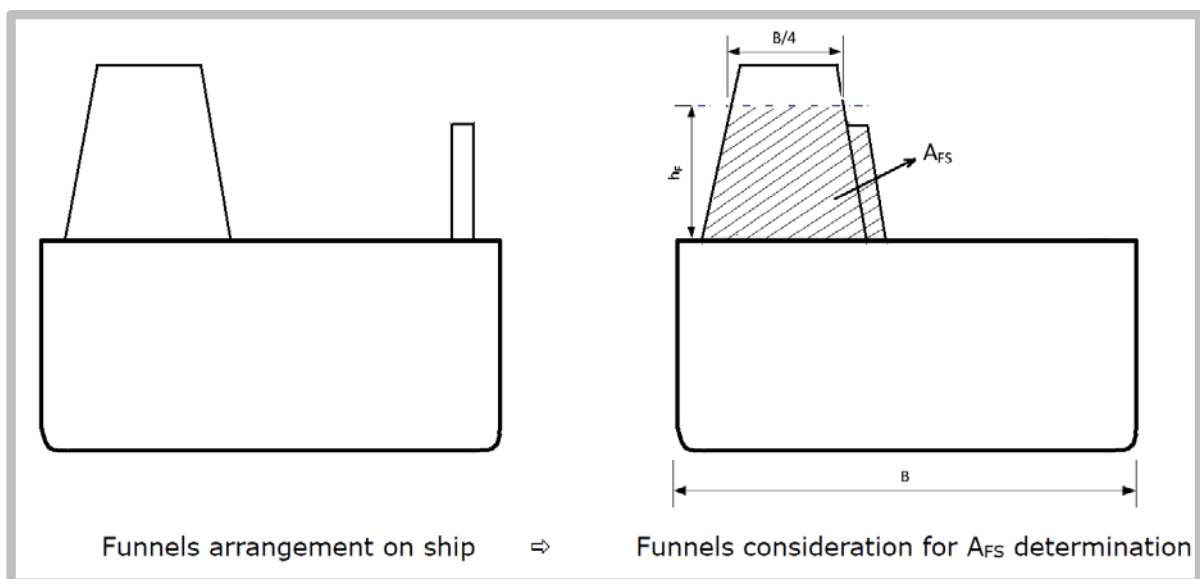


Figure 1.7.3 Computation of h_F and A_{FS} in the case of multiple funnels

7.1.5 When several funnels are fitted on the ship, the parameters mentioned in [Pt 3, Ch 1, 7.1 Calculation of Equipment Number 7.1.1](#) are to be taken as follows:

- h_F : effective height of the funnel, in m, measured from the upper deck, or notional deck line where there is local discontinuity in the upper deck, and the top of the highest funnel. The top of the highest funnel may be taken at the level where the sum of each funnel breadth reaches $\frac{B}{4}$ as shown in the [Figure 1.7.3 Computation of \$h_F\$ and AFS in the case of multiple funnels](#). When one funnel is fully or partially shielded by another funnel, the shielded area shall be omitted in calculating the sum total breadth of the funnels.
- A_{FS} : sum of the front projected area of each funnel, in m², calculated between the upper deck, or notional deck line where there is local discontinuity in the upper deck, and the effective height h_F . A_{FS} is to be taken equal to zero if the sum of each funnel breadth is less than or equal to $\frac{B}{4}$ at all elevations along the funnel's height. When one funnel is fully or partially shielded by another funnel, the shielded area shall be omitted.
- A : Side projected area, in m², of the hull, superstructures, houses and funnels above the summer load waterline which are within the Rule length of the ship. The total side projected area of the funnels is to be considered in the side projected area of the ship, A , when A_{FS} is greater than zero. The shielding effect of funnels in the transverse direction may be considered in the total side projected area, i.e. when the side projected areas of two or more funnels fully or partially overlap, the overlapped area needs only to be counted once.

Existing paragraphs 7.1.5 to 7.1.8 have been renumbered 7.1.6 to 7.1.9.

Part 3, Chapter 4 Longitudinal Strength

■ Section 5 Hull bending strength

5.3 Design still water bending moments

5.3.4 Where the amount and disposition of consumables at any intermediate stage of the voyage are considered more severe, calculations for such intermediate conditions are to be submitted in addition to those for departure and arrival conditions. Also where any ballasting and/or de-ballasting is intended during voyage, calculations of the intermediate condition just before and just after ballasting and/or de-ballasting any tank are to be submitted and, where approved, included in the loading manual for guidance. The specified percentage consumables for a given condition is based on the overall percentage filling for a consumable type, e.g. for 50 per cent consumables, the loading for each consumable type is to be 50 per cent, i.e. 50 per cent fresh water, 50 per cent fuel oil etc. Individual tanks within consumable groups can have filling levels greater than the overall specified percentage filling level.

5.3.5 Ballast loading conditions involving partially filled peak and/or other ballast tanks at departure, arrival or during intermediate conditions are not permitted as design conditions unless the design stress limits are satisfied for all filling levels between empty and full, and for bulk carriers the requirements of [Pt 4, Ch 7, 3 Longitudinal strength](#), as applicable, are to be complied with for all filling levels between empty and full. To demonstrate compliance with all filling levels between empty and full, it will be acceptable if, in each condition at departure, arrival and where required by [Pt 3, Ch 4, 5.3 Design still water bending moments 5.3.3](#), any intermediate condition, the tanks intended to be partially filled are assumed to be:

- empty
- full
- partially filled at intended level.

Where multiple tanks are intended to be partially filled, all combinations of empty, full or partially filled at intended level for those tanks are to be investigated.

See also [Pt 3, Ch 4, 5.3 Design still water bending moments 5.3.7](#) and [Pt 3, Ch 4, 5.3 Design still water bending moments 5.3.8](#) for ore carriers and [Pt 3, Ch 4, 5.3 Design still water bending moments 5.3.6](#) for cargo ships in general except container ships.

Where multiple tanks are intended to be partially filled, all combinations of empty, full or partially filled at intended level for those tanks are to be investigated. However, for conventional ore carriers with large wing water ballast tanks in cargo area, where empty or full ballast water filling levels of one or maximum two pairs of these tanks lead to the ship's trim exceeding one of the following conditions, it is sufficient to demonstrate compliance with maximum, minimum and intended partial filling levels of these one or maximum two pairs of ballast tanks such that the ship's condition does not exceed any of these trim limits. Filling levels of all other wing ballast tanks are to be considered between empty and full. The trim conditions mentioned above are:

- trim by stern of 3 per cent of the ship's length, or
- trim by bow of 1.5 per cent of ship's length, or
- any trim that cannot maintain propeller immersion (l/D) not less than 25 per cent, where;

l = the distance from propeller centreline to the waterline, see [Figure 4.5.1 Propeller immersion](#)

D = propeller diameter, see [Figure 4.5.1 Propeller immersion](#)

The maximum and minimum filling levels of the above mentioned pairs of side ballast tanks are to be indicated in the loading manual.

5.3.6 Cargo ships which might have one ballast water tank (or one pair of ballast water tanks) partially filled in ballast loading conditions are to be considered as either Case A or Case B as appropriate where;

Case A covers cargo ships where partial filling of a ballast water tank is permitted and may take place at any point during the ballast voyage. Intermediate conditions are to be specified, see also [Pt 3, Ch 4, 5.3 Design still water bending moments 5.3.4](#); however, the filling/partial filling of the ballast water tank can be done at any step, in order to keep acceptable trim and propeller immersion during the ballast voyage. For the purposes of strength verification, the following loading conditions are to be considered;

- ballast tank full at departure and arrival; and
- ballast tank empty at departure and arrival.

Case B covers cargo ships where partial filling of a ballast tank to a given level is only permitted during intermediate conditions, see also [Pt 3, Ch 4, 5.3 Design still water bending moments 5.3.4](#), between a given range of consumables, e.g. between 50 percent and 20 percent consumables. For the purposes of strength verification, the following loading conditions are to be considered;

- ballast tank full at upper filling level of consumables (i.e. if the given range of consumables is between 50 per cent and 20 per cent, then the ballast tank is to be considered as full at 50 percent consumables); and
- ballast tank empty at lower filling level of consumables (i.e. if the given range of consumables is between 50 per cent and 20 per cent, then the ballast tank is to be considered as empty at 20 per cent consumables); and
- ballast tank empty at upper filling level of consumables (i.e. if the given range of consumables is between 50 per cent and 20 per cent, then the ballast tank is to be considered as full at 50 per cent consumables); and
- ballast tank full at lower filling level of consumables (i.e. if the given range of consumables is between 50 per cent and 20 per cent, then the ballast tank is to be considered as empty at 20 per cent consumables).

For Case B ships, clear operational guidance for partial filling of ballast tanks, in association with the consumption level is to be given in the loading manual.

5.3.7 Conventional ore carriers (with usual arrangement of WBT) with two pairs of partially filled ballast water tanks are to be considered as Case C. Operational loading conditions are to be considered in association with specified filling levels of the ballast tanks intended to be partially filled, see [Table 4.5.2 Loading conditions for conventional ore carrier with two pairs of partially filled tanks](#). For the purposes of strength verification, combinations of ballast tank filling levels are to be considered for the departure, arrival and intermediate conditions, see [Table 4.5.3 Strength conditions for conventional ore carrier with two pairs of partially filled tanks](#);

Table 4.5.2 Loading conditions for conventional ore carrier with two pairs of partially filled tanks

Loading condition	Consumables, see Note	WBT Filling level
Departure	100%	Dep %
Intermediate 1	50%	Dep %
Intermediate 2	50%	Int %
Intermediate 3	20%	Int %
Intermediate 4	20%	Arr %
Arrival	10%	Arr %

Note Percentage consumables to be specified, indicated as 50% and 20%, see also [Pt 3, Ch 4, 5.3 Design still water bending moments 5.3.4](#)

Table 4.5.3 Strength conditions for conventional ore carrier with two pairs of partially filled tanks

Strength condition	Departure		Intermediate 1		Intermediate 2		Intermediate 3		Intermediate 4		Arrival	
	WBT A	WBT F	WBT A	WBT F	WBT A	WBT F	WBT A	WBT F	WBT A	WBT F	WBT A	WBT F
1	Max	Dep %	Max	Dep %	Max	Int %	Max	Int %	Max	Arr %	Max	Arr %
2	Min	Dep %	Min	Dep %	Min	Int %	Min	Int %	Min	Arr %	Min	Arr %
3	Full	Max	Full	Max	Int %	Max	Full	Max	Arr %	Max	Full	Max

4	Full	Min	Full	Min	Int %	Min	Full	Min	Arr %	Min	Full	Min
5	Empty	Max	Empty	Max			Empty	Max			Empty	Max
6	Empty	Min	Empty	Min			Empty	Min			Empty	Min
7	Dep %	Max	Dep %	Max			Int %	Max			Arr %	Max
8	Dep %	Min	Dep %	Min			Int %	Min			Arr %	Min
9	Max	Full	Max	Full			Max	Full			Max	Full
10	Min	Full	Min	Full			Min	Full			Min	Full
11	Max	Empty	Max	Empty			Max	Empty			Max	Empty
12	Min	Empty	Min	Empty			Min	Empty			Min	Empty

Note 1. Maximum and minimum filling levels of ballast tanks are to be in accordance with the trim limitations specified in [Pt 3, Ch 4, 5.3 Design still water bending moments 5.3.8](#).

Note 2. WBT A refers to the aft partially filled ballast tank. WBT F refers to the forward partially filled ballast tank.

5.3.8 For conventional ore carriers with large wing water ballast tanks in the cargo area, where empty or full ballast water filling levels of one or maximum two pairs of these tanks lead to the ship's trim exceeding one of the following conditions, it is sufficient to demonstrate compliance with maximum, minimum and intended partial filling levels of the ballast tanks, such that the ship's condition does not exceed any of these trim limits. Filling levels of all other wing ballast tanks are to be considered between empty and full. The trim conditions mentioned above are:

- trim by stern of 3 per cent of the ship's length, or
- trim by bow of 1,5 per cent of ship's length, or
- any trim that cannot maintain propeller immersion (I/D) of at least 25 per cent,

where

I = the distance from propeller centreline to the waterline, see [Figure 4.5.1 Propeller immersion](#)

D = propeller diameter, see [Figure 4.5.1 Propeller immersion](#)

The maximum and minimum filling levels of the above-mentioned pairs of side ballast tanks are to be indicated in the loading manual.

Existing paragraphs 5.3.6 and 5.3.7 have been renumbered as 5.3.9 and 5.3.10.

■ **Section 8** **Loading guidance information**

8.3 Loading instrument

8.3.1 In addition to a Loading Manual, an approved type loading instrument is to be provided for all ships where L is greater than 65 m and which are approved for non-uniform distribution of loading. The following ships are exempt from this requirement except as indicated in [Pt 3, Ch 4, 8.3 Loading instrument 8.3.2](#):

- Ships with very limited possibilities for variations in the distribution of cargo and ballast.
- Ships with a regular or fixed trading pattern.
- Ships exempt by individual Chapters in [Pt 4 Ship Structures \(Ship Types\)](#).

8.3.2 An approved type loading instrument is to be provided where a **ShipRight SDA** notation is assigned to a passenger ship, roll on-roll off passenger ship or roll on-roll off cargo ship. See also [Pt 4, Ch 2, 2.1 General 2.1.5](#).

Existing paragraphs 8.3.2 to 8.3.10 have been renumbered 8.3.3 to 8.3.11.

Part 3

Chapter 9

Special Features

■ Section 3

Decks loaded by wheeled vehicles

3.4 Deck plating

(Part only shown)

Table 9.3.1 Deck plate thickness calculation

Symbols		Expression	
a, s, u, and v as defined in Figure 9.3.1 Tyre print chart		$P_1 = \varphi_1 \varphi_2 \varphi_3 \lambda P_w$	
n	= tyre connection correction factor, see Table 9.3.3 Tyre correction factor, n	$\varphi_1 = \frac{2v_1 + 1,1s}{u_1 + 1,1s}$ $\varphi_1 = \frac{2v_1 + 1,1s}{u_1 + 1,1s}$	$v_1 = v, \text{ but } \leq s$ $u_1 = u, \text{ but } \leq a$
φ_2	= panel aspect ratio correction factor	λ	$= (1 + na_z)$ $= 1,25 \text{ for harbour conditions}$ $= (1 + 0,7n) \text{ for sea-going conditions}$
φ_3	= wide patch load factor		
a_z	= vertical acceleration at the location under consideration, see Pt 3, Ch 9, 9.2 Loading 9.2.3		

■ Section 6

Lifting appliances and support arrangements

6.1 General

6.1.1 Where a vessel has been assigned a special features class notation associated with lifting appliances, the applicable lifting appliances are to be built in accordance with the requirements of LR's [Code for Lifting Appliances in a Marine Environment](#).

6.1.2 Where the lifting appliance is considered to be an essential feature of a classed vessel, the special feature class notation **LA** or **LA** will, in general, be mandatory.

6.1.3 It is the responsibility of the designer to ensure that the ship is suitable for the intended lifting appliance operations. Particular attention is drawn to ships or units which have:

- (a) been assigned the class notation **LA**;
- (b) been assigned the class notation **CG**;
- (c) been assigned the class notation **OC**;
- (d) been assigned the class notation **PLS**; or
- (e) heavy lift cranes (or lifting appliances) installed (see [Ch 4, 1.2 Lifting appliances and crane types 1.2.1 \(k\)](#) of the [Code for Lifting Appliances in a Marine Environment](#)).

See also [Pt 3, Ch 9 Special Features, Table 9.6.1 Special features class notations associated with lifting appliances](#).

Existing paragraphs 6.1.3 to 6.1.5 have been renumbered 6.1.4 to 6.1.6.

~~6.1.1~~ **6.1.7** Masts, derrick posts, crane pedestals and similar supporting structures are classification items, and the scantlings and arrangements are to comply with LR's requirements whether or not LR is also requested to issue the ~~Register of Ships' Cargo Gear and Lifting Appliances~~ Register of Ship's Lifting Appliances and Cargo Handling Gear.

Part 3, Chapter 13

Ship Control Systems

■ Section 1 General

1.1 Application

1.1.2 The requirements in this Chapter are not applicable to ~~Double Hull Oil Tankers or Bulk Carriers~~ double hull tankers or bulk carriers with a **CSR** notation (see [Pt 1, Ch 2, 2.3 Class notations \(hull\)](#)) with the exception of the following:

- For ~~Double Hull Tankers~~ double hull tankers and bulk carriers; Sections [Pt 3, Ch 13, 2 Rudders](#) to [Pt 3, Ch 13, 6 Stabiliser structure](#) are to be complied with as applicable.
- ~~For Bulk Carriers; Sections [Pt 3, Ch 13, 3 Fixed and steering nozzles](#) to [Pt 3, Ch 13, 6 Stabiliser structure](#) and Section [Pt 3, Ch 13, 12 Emergency towing arrangements](#) are to be complied with as applicable.~~
- For double hull oil tankers and bulk carriers [Pt 3, Ch 13, 7 Equipment](#) to [Pt 3, Ch 13, 9 Structural requirements associated with towing and mooring](#) are to be complied with as applicable, except where alternative requirements are specified in [IACS Common Structural Rules for Bulk Carriers and Oil Tankers](#).

■ Section 7 Equipment

7.5 Mooring lines (Equipment Number ≤ 2000)

7.5.1 It is recommended that the ~~breaking strength~~ ship design minimum breaking load, length and number of mooring lines provided on board ships with equipment number of less than or equal to 2000 be not less than those specified in [Table 13.7.4 Equipment – Stream anchors, stream wires, towlines and mooring lines](#). The Equipment Number is to be calculated in accordance with [Pt 3, Ch 1, 7.1 Calculation of Equipment Number](#). ~~Deck cargo as given by the loading manual is~~ cargoes at the ship nominal capacity condition are to be included in the determination of side-projected area *A* to be used in this sub-Section including the equipment number calculations. The nominal capacity condition is defined in [Pt 3, Ch 13, 9.1 General 9.1.7](#) and the ship design minimum breaking load is defined in [Pt 3, Ch 13, 9.1 General 9.1.8](#).

7.5.2 It is the ~~Owner's~~ Owner and designer's responsibility to ensure the adequacy of the mooring equipment. ~~The equipment should be verified through carrying out ship specific mooring calculations. The mooring calculations are to be representative of the anticipated mooring configurations, as well as accounting for operational and environmental considerations. This section details minimum recommendations only, and where the calculations provide a lesser specification it is recommended that they be increased in accordance with this section.~~ The adequacy of minimum recommended mooring lines in this sub-Section needs to be verified based on assessments carried out for the individual mooring arrangement, expected shore-side mooring facilities and design environmental conditions for the berth.

7.5.5 As an alternative to the minimum recommendations for mooring lines prescribed in this sub-Section, the minimum recommendations for mooring lines may be determined by direct mooring analysis in accordance with the procedure given in Appendix A of IACS Recommendation 10 *Chain Anchoring, Mooring and Towing Equipment*.

7.6 Mooring lines (Equipment Number > 2000)

7.6.1 The recommended ~~minimum breaking strength~~ ship design minimum breaking load, length and number of mooring lines for ships with equipment number greater than 2000, calculated in accordance with [Pt 3, Ch 1, 7.1 Calculation of Equipment Number](#) are provided in this sub-Section. ~~Deck cargo as given by the Loading Manual is~~ cargoes at the ship nominal capacity condition are to be included in the determination of side-projected area *A* to be used in the equipment number calculations. The nominal capacity condition is defined in [Pt 3, Ch 13, 9.1 General 9.1.7](#) and the ship design minimum breaking load is defined in [Pt 3, Ch 13, 9.1 General 9.1.8](#).

7.6.2 It is the ~~Owner's~~ Owner and designer's responsibility to ensure the adequacy of the mooring equipment. ~~The equipment should be verified through carrying out ship specific mooring calculations. The mooring calculations are to be representative of the anticipated mooring configurations, as well as accounting for operational and environmental considerations. This section details minimum recommendations only, and where the calculations provide a lesser specification it is recommended that they be increased in accordance with this section.~~ The adequacy of minimum recommended mooring lines in this sub-Section needs to be verified based on assessments carried out for the individual mooring arrangement, expected shore-side mooring facilities and design environmental conditions for the berth. A typical mooring arrangement is indicated in [Figure 13.7.1 Typical mooring arrangement](#) and the following is defined with respect to mooring lines.

- (a) Breast line: A mooring line that is deployed perpendicular to the ship, restraining the ship in the off-berth direction.
- (b) Spring line: A mooring line that is deployed almost parallel to the ship, restraining the ship in the fore or aft direction.
- (c) Head/stern line: A mooring line that is oriented between longitudinal and transverse direction, restraining the ship in the off-berth and in the fore or aft direction. The amount of restraint in fore or aft and off-berth direction depends on the line angle relative to these directions.

7.6.3 The strength of mooring lines and the number of head, stern, and breast lines for ships with an Equipment Number > 2000 are based on the side-projected area A_1 . Side projected area A_1 is to be calculated similar to the side-projected area A according to [Pt 3, Ch 1, 7.1 Calculation of Equipment Number](#) but considering the following conditions:

- For oil tankers, chemical tankers, bulk carriers, and ore carriers, the lightest ballast draft is to be considered for the calculation of the side-projected area A_1 . For other ships the lightest draft of usual loading conditions is to be considered if the ratio of the freeboard in the lightest draft and the full load condition is equal to or above two. Usual loading conditions mean loading conditions as given by the trim and stability booklet that are to be expected to regularly occur during operation and, in particular, excluding light weight conditions, propeller inspection conditions, etc.
The ballast draught should be considered for the calculation of the side-projected area A_1 . For ship types having small variation in the draught, e.g. passenger and Ro/Ro vessels, the side projected area A_1 may be calculated using the summer load waterline.
- Wind shielding of the pier can be considered for the calculation of the side-projected area A_1 unless the ship is intended to be regularly moored to jetty type piers. The lower part of the side-projected area above the waterline for the considered loading condition can be disregarded up to the pier height in the calculation of the side-projected area A_1 . Where known, the actual height of the pier above the waterline may be used in the calculation. If the pier height cannot be pre-determined, an assumed height may be used. However, in both cases, the pier height shall not exceed 3 m.
- Deck cargo as given by the Loading Manual is cargoes at the ship nominal capacity condition are to be included for the determination of side-projected area A_1 . For the condition with cargo on deck, the summer load waterline may be considered. Deck cargoes need not be considered if the usual light draft ballast draught condition without cargo on deck generates a larger side-projected area A_1 than the full load condition with cargoes on deck. The larger of both side-projected areas should be chosen as side-projected area A_1 . The nominal capacity condition is defined in [Pt 3, Ch 13, 9.1 General 9.1.7](#).

7.6.5 The maximum wind speed V_w is representative of the mean wind speed over a 30 second period from any direction and at a height of 10 m above the ground. The current speed considered is a representative of the maximum current speed acting on bow or stern ($\pm 10^\circ$) at a depth of one-half of the mean draft draught. Furthermore, it is considered that the ship is moored to solid piers that provide shielding against cross currents.

7.6.7 The minimum breaking strength ship design minimum breaking load (MBL_{SD}), in kN, of the mooring lines (MBL) is to be taken as:

$$MBL_{SD} = 0,1 \times A_1 + 350$$

where

A_1 = Side projected area as defined by [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.3](#)

7.6.8 The minimum breaking strength ship design minimum breaking load may be limited to 1275 kN (130 tonnes). However in these cases, moorings are to be considered as not sufficient for the environmental conditions given by [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.4](#). For these ships, the acceptable wind speed V_w^* , in m/s, is to be calculated as follows:

$$V_w^* = V_w \times \sqrt{\frac{MBL^*}{MBL_{SD}}}$$

$$V_w^* = V_w \times \sqrt{\frac{MBL^*_{SD}}{MBL_{SD}}}$$

where

V_w = wind speed as per [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.4](#)

MBL^* MBL^*_{SD} = the breaking strength of the mooring lines intended to be supplied the intended ship design minimum breaking load

MBL MBL_{SD} = required breaking strength ship design minimum breaking load provided by [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment number > 2000\) 7.6.7](#)

However, the intended minimum breaking strength MBL^* ship design minimum breaking load MBL^*_{SD} is not to be taken less than that corresponding to an acceptable wind speed of 21 m/s:

$$MBL^* \geq \left(\frac{21}{V_w}\right)^2 \times MBL$$

$$MBL^*_{SD} \geq \left(\frac{21}{V_w}\right)^2 \times MBL_{SD}$$

7.6.9 If then the mooring lines are intended to be supplied for an acceptable wind speed V_w^* , higher than V_w as per [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.4](#), the minimum breaking strength ship design minimum breaking load MBL^*_{SD} is to be taken as:

$$MBL^* = \left(\frac{V_w^*}{V_w}\right)^2 \times MBL$$

$$MBL^*_{SD} = \left(\frac{V_w^*}{V_w}\right)^2 \times MBL_{SD}$$

where

~~MBL~~ MBL_{SD} = required ~~breaking strength~~ ship design minimum breaking load provided by [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.7](#)

7.6.10 The total number of head, stern and breast lines is specified as:

$$n = 8,3 \times 10^{-4} \times A_1 + 6$$

where

A_1 = side projected area as defined by [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.3](#)

However, for oil tankers, chemical tankers, bulk carriers and ore carriers the total number of head, stern and breast lines is to be taken as:

$$n = 8,3 \times 10^{-4} \times A_1 + 4$$

The total number of head, stern and breast lines is to be rounded to the nearest whole number. The number may be increased or decreased in conjunction with an adjustment to the ~~strength~~ of the ~~lines~~ ship design minimum breaking load. The adjusted ~~strength~~,

~~MBL*~~, ship design minimum breaking load, MBL_{SD}^{**} is to be taken as:

~~$$MBL^* = 1,2 \times MBL \times \frac{n}{n^*} \leq MBL, \text{ for increased number of lines}$$~~

~~$$MBL^* = MBL \times \frac{n}{n^*}, \text{ for reduced number of lines}$$~~

$$MBL_{SD}^{**} = 1,2 \times MBL_{SD} \times \frac{n}{n^{**}} \leq MBL_{SD}, \text{ for increased number of lines}$$

$$MBL_{SD}^{**} = MBL_{SD} \times \frac{n}{n^{**}}, \text{ for reduced number of lines}$$

where

MBL_{SD} = MBL_{SD} or MBL_{SD}^* , if the intended ship design minimum breaking load is different as provided by [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.8](#) or [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.9](#)

n = number of lines for the considered ship type as calculated by the above formula without rounding

~~n^*~~ n^{**} = increased or decreased total number of head, stern and breast lines.

Vice versa, the ~~strength~~ ship design minimum breaking load of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the number of lines.

7.6.11 The total number of spring lines, n_s is to be taken not less than:

Two lines where $EN < 5000$,
Four lines where $EN \geq 5000$.

The ~~strength~~ ship design minimum breaking load of spring lines is to be the same as that of the head, stern and breast lines. If the number of head, stern and breast lines is increased in conjunction with an adjustment to the ~~strength~~ ship design minimum breaking load of the lines, then the number of spring lines is also to be ~~increased likewise~~ taken as follows, but rounded up to the nearest even number.

$$n_s^* = \frac{MBL_{SD}}{MBL_{SD}^{**}} \times n_s$$

where

$MBL_{SD} = MBL_{SD}$ or MBL_{SD}^* , if the intended ship design minimum breaking load is different as provided by [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.8](#) or [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.9](#)

MBL_{SD}^{**} = adjusted ship design minimum breaking load as provided by [Pt 3, Ch 13, 7.6 Mooring lines \(Equipment Number > 2000\) 7.6.10](#)

n_s = the number of spring lines as given above

n_s^* = the increased number of spring lines

7.6.13 As an alternative to the minimum recommendations for mooring lines prescribed in this sub-Section, the minimum recommendations for mooring lines may be determined by direct mooring analysis in accordance with the procedure given in Appendix A of IACS Recommendation 10 'Chain Anchoring, Mooring and Towing Equipment'.

7.7 Mooring Arrangement and winches

7.7.5 The mooring winch is to be fitted with brakes, the holding capacity of which is sufficient to prevent unreeling of the mooring line when the rope tension is equal to 80 per cent of the ~~minimum breaking strength~~ ship design minimum breaking load of the rope as fitted on the first layer. The winch is to be fitted with brakes that will allow for the reliable setting of the brake rendering load.

7.7.6 For powered winches the maximum hauling tension which can be applied to the mooring line (the reeled first layer) is to be not less than 2/9, nor to be more than, 1/3, of the rope's ~~minimum breaking strength~~ ship design minimum breaking load. For automatic winches these figures apply when the winch is set to the maximum power with automatic control.

7.8 Towline and towing arrangement

7.8.1 The recommended towlines are given in [Table 13.7.4 Equipment – Stream anchors, stream wires, towlines and mooring lines](#) and are intended as ship's own towline, for being towed by a tug or another ship. It is the Owner and designer's responsibility to ensure the adequacy of towing lines based on assessments carried out for the individual towing arrangement. This sub-Section also provides recommendations with respect to the towing arrangement.

7.9 Mooring and towline construction

7.9.2 Notwithstanding the strength recommendations in [Pt 3, Ch 13, 7.5 Mooring lines \(Equipment Number ≤ 2000\)](#), [Pt 3, Ch 13 7.6 Mooring lines \(Equipment Number > 2000\)](#) and [Pt 3, Ch 13, 7.8 Towline and towing arrangement](#), no fibre rope shall be less than 20 mm in diameter. For polyamide ropes the minimum breaking strength line design break force is to be increased by 20 per cent and for other synthetic ropes by 10 per cent to account for strength loss due to, among other causes, aging and wear. The line design break force is defined in [Pt 3, Ch 13, 9.1 General 9.1.9](#).

(Part only shown)

Table 13.7.4 Equipment – Stream anchors, stream wires, towlines and mooring lines

Equipment Number		Stockless stream anchor	Stream wire or chain (see Note 1)		Mooring lines (see Note 2)			Towline	
Exceeding	Not exceeding	Mass per anchor (kg)	Length (m)	Breaking strength (kN)	No. of mooring lines	Minimum length of each line (m)	Minimum breaking strength Ship design minimum breaking load (kN)	Minimum length (m)	Minimum breaking strength Ship design minimum breaking load (kN)

(Part only shown)

Table 13.7.5 Equipment for fishing vessels

Equipment Number		Stockless bower anchors		Stud link chain cables for bower anchors			Mooring lines		
Exceeding	Not exceeding	Number	Mass per anchor (kg)	Total length (m)	Minimum diameter (mm)		Number	Minimum length of each line (m)	Minimum breaking strength Ship design minimum breaking load (kN)
					Mild steel (Grade U1) See Note 1	Special quality steel (Grade U2)			

■ Section 8 Anchor windlass design and testing

8.10 On-board testing

8.10.2 The mean hoisting speed, as specified in [Pt 3, Ch 13, 8.4 Windlass design 8.4.1.\(e\)](#) is to be measured and verified. For testing purposes, the speed is to be measured over two shots of chain cable and initially with at least three shots of chain (82,5 m or 45 fathoms in length) and the anchor submerged and hanging free. Following trials, the ship will be eligible to be assigned a descriptive note **specified design anchorage depth . . . metres**, which will be entered in column 6 of the Register Book.

During trials on board ship, the windlass is to be shown to be capable of:

- For all specified design anchorage depths, the mean hoisting speed, as specified in [Pt 3, Ch 13, 8.4 Windlass design 8.4.1.\(e\)](#) is to be measured and verified. For testing purposes, the speed is to be measured over two shots of chain cable and initially with at least three shots of chain (82,5 m or 45 fathoms in length) and the anchor submerged and hanging free.
- For specified design anchorage depths greater than 82,5 m: in addition to [Pt 3, Ch 13, 8.10 On-board testing 8.10.2 \(a\)](#), raising the anchor from the specified design anchorage depth to a depth of 82,5 m at a mean speed of 3 m/min.

Following trials, the ship will be eligible to be assigned a descriptive note **specified design anchorage depth . . . metres**, which will be entered in column 6 of the Register Book.

8.12 Structural requirements associated with anchoring

Table 13.8.2 Allowable stresses in windlass and chain stopper supporting structure

	Permissible stress N/mm ²
(a) For strength assessment by means of beam theory or grillage analysis (see Note 1):	
Normal stress (see Note 1)	1,00 σ_0
Shear stress	0,58 0,60 σ_0
Combined Stress (see Note 2) Von Mises stress	1,00 σ_0
(b) For strength assessment by means of finite element analysis (see Note 2):	
Von Mises stress	1,00 σ_0
Symbols	
σ_0 = specified minimum yield stress, N/mm ²	
<p>Note 1 Normal stress is defined as the sum of bending and axial stresses. The shear stress to be considered corresponds to the shear stress acting perpendicular to the normal stress. No stress concentration factors are to be taken into account.</p> <p>Note 2 Combined stress refers to equivalent von Mises stress. For strength assessment by means of finite element analysis, the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs, the web thickness is to be reduced to an appropriate mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled using shell or plane stress elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modelled using shell or plane stress elements, then dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element.</p>	

■ Section 9

Structural requirements associated with towing and mooring

9.1 General

9.1.7 The nominal capacity condition is defined as the theoretical condition where the maximum possible deck cargoes are included in the ship arrangement in their respective positions. For container ships, the nominal capacity condition represents the theoretical condition where the maximum possible number of containers is included in the ship arrangement in their respective positions.

9.1.8 Ship Design Minimum Breaking Load (MBL_{SD}) is the minimum breaking load of new, dry mooring lines or tow line for which shipboard fittings and supporting hull structures are designed in order to meet mooring restraint requirements or the towing requirements of other towing service.

9.1.9 Line Design Break Force ($LDBF$) is the minimum force at which a new, dry, spliced, mooring line will break at. This is applicable to all synthetic cordage materials.

9.2 Towing

9.2.1 The strength of shipboard fittings used for normal towing operations at bow, sides and stern and their supporting hull structures are to comply with the requirements specified in this sub-Section. For fittings intended to be used for both towing and mooring, [Pt 3, Ch 13, 9.3 Mooring](#) is also to be applied.

Table 13.9.1 Minimum design load for deck fittings and supporting structure – Towing

Use/Item	Minimum design load (see Notes 1 to 3)
Normal towing (harbour/manoeuvring)	1,25 times the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan
Other towing service (SOLAS Regulation II-1/3-4 Paragraph 2)	Minimum breaking strength of the towline Ship design minimum breaking load given in Pt 3, Ch 13, 7.8 Towline and towing arrangement
For fittings intended to be used for both normal towing and other towing service	The greater of the specified loads in each case

Note 1. When a safe towing load TOW greater than that determined according to [Pt 3, Ch 13, 9.2 Towing 9.2.12b](#) is requested, then the design load is to be increased in accordance with the appropriate TOW/design load relationship given in this sub-Section.

Note 2. Side projected area including that of deck cargoes as given by the loading manual the ship nominal capacity condition is to be taken into account for selection of towing lines and the loads applied to shipboard fittings and supporting hull structures. The nominal capacity condition is defined in [Pt 3, Ch 13, 9.1 General 9.1.7](#).

Note 3. The increase of the minimum breaking strength line design break force for synthetic ropes need not to be taken into account for the loads applied to shipboard fittings and supporting hull structures.

9.2.6 Shipboard fittings are to be selected from an acceptable National or International standard and to be based on the following minimum loads.

- For normal towing operations, the intended maximum towing load (e.g. static bollard pull) as indicated on the towing and mooring arrangements plan;
- For other towing service, the minimum breaking strength of the towline ship design minimum breaking load in accordance with [Pt 3, Ch 13, 7.8 Towline and towing arrangement](#) (see Notes 2 and 3 of [Table 13.9.1 Minimum design load for deck fittings and supporting structure - Towing](#));
- For fittings intended to be used for both, i.e. normal and other towing operations, the greater of the loads specified in each case is to be used.

9.2.8 When the shipboard fitting is not selected from an accepted industry standard, the strength of the fitting based on net scantlings and its attachment to the ship is to be adequate for the loads specified by the [Table 13.9.1 Minimum design load for deck fittings and supporting structure - Towing](#) based on the acceptance criteria given in [Pt 3, Ch 13, 9.2 Towing 9.2.10](#) or [Pt 3, Ch 13, 9.2 Towing 9.2.11](#) as appropriate. The capability of the structure to withstand buckling is also to be assessed. Towing bitts (double bollards) are required to resist the loads caused by the towing line attached with an eye splice. For strength assessment, beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions and wear down allowance is to be added to the net scantlings as defined in this Section.

9.2.9 The net scantlings of the supporting hull structure for the fittings are to be adequate for the loads specified by the [Table 13.9.1 Minimum design load for deck fittings and supporting structure - Towing](#) based on the acceptance criteria given in by [Pt 3, Ch 13, 9.2 Towing 9.2.10](#) or [Pt 3, Ch 13, 9.2 Towing 9.2.11](#) as appropriate. The capability of the structure to withstand buckling is also to be assessed. The reinforced members beneath shipboard fittings are to be effectively arranged for any variation of direction (horizontally and vertically) of the towing forces acting upon the shipboard fittings, see [Figure 13.9.2 Supporting hull structure](#) for a sample arrangement. Proper alignment of the fitting and its supporting hull structure is to be ensured. The acting point of the towing force on a shipboard fitting is to be taken at the attachment point of a towing line or at a change in its direction. For bollards and bitts the attachment point of the towing line is to be taken not less than 4/5 of the tube height above the base as indicated in [Figure 13.9.2 Supporting hull structure](#). Corrosion additions are to be added to the net scantlings as defined in this Section.

9.2.10 In the case of strength assessment using beam theory or grillage analysis, the stress within the supporting structure of fittings with net scantlings is not to exceed that given in [Table 13.9.2 Allowable stress within the supporting structure of shipboard fittings](#).

9.2.11 For strength calculations by means of finite element analysis, the geometry is to be idealised as realistically as possible. The ratio of element length to width is not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges are generally to be modelled by beam or truss elements. At least three elements are to be used across the depth of the girder. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height. Large openings are to be modelled. Stiffeners are generally to be modelled by using shell, plane stress, or beam elements. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element. The equivalent stress within the supporting structure of fittings is not to exceed the specified minimum yield strength of the material. For strength assessment by means of finite element analysis the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web thickness is to be reduced to an appropriate mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled using shell or plane stress elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modelled using shell or plane stress elements, then dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element. The Von Mises stress within the supporting structure of fittings, calculated with net scantlings, is not to exceed the specified minimum yield strength of the material.

9.2.12 The safe towing load (TOW) is the safe load limit of shipboard fittings used for towing purposes. TOW used is not to exceed 80 per cent of the design loads specified by [Table 13.9.1 Minimum design load for deck fittings and supporting structure - Towing](#).

9.3 Mooring

9.3.1 The strength of shipboard fittings used for mooring operations and their supporting hull structures as well as the strength of supporting hull structures of winches and capstans are to comply with the requirements specified in this sub-Section. For fittings intended to be used for both mooring and towing, [Pt 3, Ch 13, 9.2 Towing](#) is also to be applied.

Table 13.9.3 Minimum design load for deck fittings and supporting structure – Mooring

Use/Item	Minimum design load (see Notes 1 to 3)
Mooring (Fittings and their supporting hull structure)	1,15 times the breaking strength ship design minimum breaking load of the mooring lines given in <i>Pt 3, Ch 13, 7.5 Mooring lines (Equipment Number ≤ 2000)</i> or <i>Pt 3, Ch 13, 7.6 Mooring lines (Equipment Number > 2000)</i> as appropriate.
Winches (Supporting hull structure only)	1,25 times the intended maximum brake holding load, where the maximum brake holding load is to be assumed not less than 80% of the minimum breaking strength ship design minimum breaking load of the mooring line given in <i>Pt 3, Ch 13, 7.5 Mooring lines (Equipment Number ≤ 2000)</i> or <i>Pt 3, Ch 13, 7.6 Mooring lines (Equipment Number > 2000)</i> as appropriate.
Capstans (Supporting hull structure only)	1,25 times the maximum hauling in force, where hauling in force is defined as the maximum pull of the capstan or 1,25 times the intended maximum brake holding load if that be greater.
<p>Note 1. When a safe working load SWL greater than that determined according to the Rules is requested, the design load is to be increased in accordance with the appropriate SWL/design load relationship given in <i>Pt 3, Ch 13, 9.3 Mooring 9.3.12</i>.</p> <p>Note 2. Side projected area including that of deck cargoes as given by the loading manual the ship nominal capacity condition is to be taken into account for the selection of mooring lines and the loads applied to shipboard fittings and supporting hull structure. The nominal capacity condition is defined in <i>Pt 3, Ch 13, 9.1 General 9.1.7</i>.</p> <p>Note 3. The increase of the minimum breaking strength line design break force for synthetic ropes need not to be taken into account for the loads applied to shipboard fittings and supporting hull structures.</p>	

9.3.5 Shipboard fittings are to be selected from an acceptable National or International standard and to be based on the ~~minimum breaking strength of the mooring line~~ ship design minimum breaking load as given in *Pt 3, Ch 13, 7.5 Mooring lines (Equipment Number ≤ 2000)* or *Pt 3, Ch 13, 7.6 Mooring lines (Equipment Number > 2000)*, corresponding to the ship's equipment number (see Notes 2 and 3, *Table 13.9.3 Minimum design load for deck fittings and supporting structure - Mooring*).

9.3.6 Mooring bitts (double bollards) are to be chosen for the mooring line attached in figure-of-eight fashion if the industry standard distinguishes between different methods to attach the line, i.e. figure-of-eight or eye-splice attachment. With the line attached to a mooring bitt in the usual way (figure-of-eight fashion), either of the two posts of the mooring bitt can be subjected to a force twice as large as that acting on the mooring line. Disregarding this effect, depending on the applied industry standard and fitting size, overload may occur.

9.3.7 When the shipboard fitting is not selected from an accepted industry standard, the strength of the fitting based on net scantlings and its attachment to the ship is to be adequate for the loads specified in *Table 13.9.3 Minimum design load for deck fittings and supporting structure - Mooring* based on the acceptance criteria given in *Pt 3, Ch 13, 9.3 Mooring 9.3.10* or *Pt 3, Ch 13, 9.3 Mooring 9.3.11* as appropriate. The capability of the structure to withstand buckling is also to be assessed. Mooring bitts (double bollards) are required to resist the loads caused by the mooring line attached in figure-of-eight fashion. For strength assessment, beam theory or finite element analysis using net scantlings is to be applied, as appropriate. Corrosion additions and wear down allowance is to be added as defined in this Section.

9.3.8 The net scantlings of the supporting hull structure for the fittings are to be adequate for the loads given in *Table 13.9.3 Minimum design load for deck fittings and supporting structure - Mooring* based on the acceptance criteria given in *Pt 3, Ch 13, 9.3 Mooring 9.3.10* or *Pt 3, Ch 13, 9.3 Mooring 9.3.11* as appropriate. The capability of the structure to withstand buckling is also to be assessed. The arrangement of reinforced members beneath shipboard fittings, winches and capstans is to consider any variation of direction (horizontally and vertically) of the mooring forces acting upon the shipboard fittings, see *Figure 13.9.3 Supporting hull structure* for a sample arrangement. Proper alignment of fitting and supporting hull structure is to be ensured. The acting point of the mooring force on shipboard fittings is to be taken at the attachment point of a mooring line or at a change in its direction. Corrosion additions are to be added to the net scantlings as defined in this Section.

9.3.10 In the case of strength assessment using beam theory or grillage analysis, the stress within the supporting structure of fittings, with net scantlings, is not to exceed that given in *Table 13.9.2 Allowable stress within the supporting structure of shipboard fittings*.

9.3.11 — ~~For strength calculations by means of finite element analysis, the geometry is to be idealised as realistically as possible. The ratio of element length to width is not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges are generally to be modelled by beam or truss elements. At least three elements are to be used across the depth of the girder. In way of small openings in girder webs the web thickness is to be reduced to a mean thickness over the web height. Large openings are to be modelled. Stiffeners are generally to be modelled by using shell, plane stress, or beam elements. Stresses are to be read from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element. The equivalent stress within the supporting structure of fittings is not to exceed the specified minimum yield strength of the material.~~

For strength assessment by means of finite element analysis the mesh is to be fine enough to represent the geometry as realistically as possible. The aspect ratios of elements are not to exceed 3. Girders are to be modelled using shell or plane stress elements. Symmetric girder flanges may be modelled by beam or truss elements. The element height of girder webs must not exceed one-third of the web height. In way of small openings in girder webs the web thickness is to be reduced to an appropriate mean thickness over the web height. Large openings are to be modelled. Stiffeners may be modelled using shell or plane stress elements. The mesh size of stiffeners is to be fine enough to obtain proper bending stress. If flat bars are modelled using shell or plane stress elements, then dummy rod elements are to be modelled at the free edge of the flat bars and the stresses of the dummy elements are to be evaluated. Stresses are to be read

from the centre of the individual element. For shell elements the stresses are to be evaluated at the mid plane of the element. The Von Mises stress within the supporting structure of fittings, calculated with net scantlings, is not to exceed the specified minimum yield strength of the material.

9.3.12 The Safe Working Load (SWL) is the safe load limit of shipboard fittings used for mooring purposes. Unless a greater SWL is requested, the SWL assigned shall be the ~~minimum breaking strength of the mooring line~~ ship design minimum breaking load given in *Pt 3, Ch 13, 7.5 Mooring lines (Equipment Number ≤ 2000)* and *Pt 3, Ch 13, 7.6 Mooring lines (Equipment Number > 2000)*, corresponding to the ship's equipment number (see Notes 2 and 3 of *Table 13.9.3 Minimum design load for deck fittings and supporting structure - Mooring*). Design load on line Double bollard without fins Fitting on deck (e.g. bollard, chock) Main hull structure (e.g. web frames, deck stiffeners) Reinforcing members beneath shipboard fittings Double bollard with fins Fin

9.4 Towing and mooring arrangements plan

9.4.2 Information provided on the plan is to include in respect for each shipboard fitting:

- location on the ship;
- fitting type;
- SWL/TOW;
- purpose (mooring/harbour towing/other towing); and
- manner of applying towing or mooring line load, including limiting fleet angles i.e. angle of change in direction of a line at the fitting.

Note Item (c) with respect to items (d) and (e), is subject to approval.

Furthermore, information provided on the plan is to include:

- the arrangement of mooring lines showing number of lines (N);
- ~~the minimum breaking strength of each mooring line~~ ship design minimum breaking load (MBL_{SD} , MBL_{SD}^* or MBL_{SD}^{**} as appropriate) and;
- ~~the acceptable environmental conditions, the minimum environmental conditions are as given in~~ *Pt 3, Ch 13, 7.6 Mooring lines (Equipment Number > 2000)* for the recommended ~~minimum breaking strength of mooring lines~~ ship design minimum breaking load for ships with EN > 2000:
 - 30 second mean wind speed from any direction (V_w or V_w^*)
 - Maximum current speed acting on bow or stern ($\pm 10^\circ$).

Note Item (e) with respect to items (d) and (e), is subject to approval. Fleet angle is defined as the maximum angle the line deviates from a direction perpendicular to the drum axis of a mooring/towing winch.

9.5 Corrosion addition

9.5.1 For ships other than double hull oil tankers and bulk carriers with a CSR notation (see *Pt 1, Ch 2, 2.3 Class notations (hull)*), An allowance for corrosion is to be added to the net thickness derived as indicated below:

- For the supporting hull structure, a corrosion addition of 2 mm is to be added to the net thickness derived.
- For pedestals and foundations on deck which are not part of a fitting according to an accepted industry standard, 2,0 mm.
- For shipboard fittings not selected from an accepted industry standard, 2,0 mm.

9.5.2 For double hull oil tankers and bulk carriers with a CSR notation (see *Pt 1, Ch 2, 2.3 Class notations (hull)*), corrosion addition for the hull supporting structure is to be in accordance with IACS *Common Structural Rules for Bulk Carriers and Oil Tankers*.

■ Section 10 Anchoring equipment in deep and unsheltered water

10.3 Anchor windlass and chain stopper

10.3.1 Notwithstanding the requirements according to *Pt 3, Ch 13, 8.4 Windlass design 8.4.1*, the The windlass unit prime mover is to be able to supply for at least 30 minutes a continuous duty pull Z_{cont} , in N, given by:

$$Z_{cont} = 35 d^2 + 13,4 m_A$$

where

d = chain diameter, in mm, as per *Table 13.10.1 Anchoring equipment for ships in unsheltered water with depth up to 120 m*

m_A = HHP anchor mass, in kg, as per *Table 13.10.1 Anchoring equipment for ships in unsheltered water with depth up to 120 m*

10.3.4 As far as practicable, for testing purposes the speed of the chain cable during hoisting of the anchor and cable is to be measured over 37,5 m of chain cable and initially with at least 120 m of chain and the anchor submerged and hanging free. The mean speed of the chain cable during hoisting of the anchor from the depth of 120 m to the depth of 82,5 m is to be at least 4,5 m/min.

In addition to the requirements of *Pt 3, Ch 13, 8.10 On-board testing 8.10.2*, as far as practicable, for testing purposes the speed of the chain cable during hoisting of the anchor and cable should be measured over 37,5 m of chain cable and initially with at least 120 m of chain with the anchor submerged and hanging free. The mean speed of the chain cable during hoisting of the anchor from the depth of 120 m to the depth of 82,5 m should be at least 4,5 m/min.

Table 13.10.1 Anchoring equipment for ships in unsheltered water with depth up to 120 m

Equipment Number EN ₁		High holding power stockless bower anchors		Stud link chain cable for bower anchors		
Exceeding Equal to or greater than	Not exceeding Less than	Number	Mass per anchor (m_A) (kg)	Length (m)	Min. diameter (d)	
					Special quality (Grade U2) (mm)	Extra special quality (Grade U3) (mm)
	1790	2	14150	1017,5	105	84
1790	1930	2	14400	990	105	84
1930	2080	2	14800	990	105	84
2080	2230	2	15200	990	105	84
2230	2380	2	15600	990	105	84
2380	2530	2	16000	990	105	84
2530	2700	2	1590016300	990	105	84
2700	2870	2	1580016700	990	105	84
2870	3040	2	1570017000	990	105	84
3040	3210	2	1560017600	990	105	84
3210	3400	2	1550018000	990	105	84
3400	3600	2	1540018300	990	105106	84
3600	3800	2	1660019000	990	107	8785
3800	4000	2	1780019700	962,5	107108	87
4000	4200	2	1890020300	962,5	111	90
4200	4400	2	2010021100	962,5	114	92
4400	4600	2	22000	962,5	117	95
4600	4800	2	2240022900	962,5	120119	97
4800	5000	2	23500	962,5	124122	99
5000	5200	2	24000	935	127125	102
5200	5500	2	24500	907,5	132130	107105
5500	5800	2	25000	907,5	132133	107
5800	6100	2	25500	880	137	111
6100	6500	2	2550025700	880	142140	114113
6500	6900	2	26000	852,5	142143	117115
6900	7400	2	26500	852,5	147	117118
7400	7900	2	27000	825	152	121212
7900	8400	2	2700027500	825	154 -	127123
8400	8900	2	2700028000	797,5	158 -	127
8900	9400	2	2700028900	770	162 -	132
9400	10000	2	2700029400	770	-	135 137
10000	10700	2	2700029900	770	-	139 142
10700	11500	2	2700030600	770	-	143 142
11500	12400	2	2950031500	770	-	147
12400	13400	2	3150033200	770	-	152
13400	14600	2	3450035000	770	-	157
14600		2	38000	770	-	162

Part 4, Chapter 2 Ferries, Roll On-Roll Off Ships and Passenger Ships

■ Section 2 Longitudinal strength

2.1 General

2.1.5 The requirements of [Pt 3, Ch 4, 8.3 Loading instrument](#) regarding loading instruments are not applicable to passenger ferries, roll on-roll off passenger ferries and passenger vehicle ferries without a **ShipRight SDA** notation.

Part 4 Chapter 12 Dredging and Reclamation Craft

■ Section 2 Longitudinal strength

2.7 Hull shear strength

2.7.3 ~~The~~ For transit conditions, the vertical wave shear forces, Q_w , are to be calculated in accordance with [Pt 3, Ch 4, 6 Hull shear strength](#) where the ship service factor, K_2 , is taken as f_1 , see [Table 12.2.1 Service factors \$f_1\$ and \$f_{wd}\$ for ships with hopper or split hopper](#). ~~In dredging conditions, where the dredging draught T_m is greater than T , K_2 may be taken as f_{wd} .~~

2.7.4 For dredging conditions at draught T_m , the design hull vertical wave shear forces at any position along the ship, Q_{wd} , are given by the following expression:

$$Q_{wd} = f_{wd} K_1 Q_{wo}$$

where

T_m is the dredging draught and is not to be taken less than draught T

K_1 is given in [Pt 3, Ch 4, 6.3 Design wave shear force 6.3.1](#)

Q_{wo} is determined from [Pt 3, Ch 4, 6.3 Design wave shear force](#) using C_{bm} instead of C_b

f_{wd} is defined in [Table 12.2.1 Service factors \$f_1\$ and \$f_{wd}\$ for ships with hopper or split hopper](#)

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